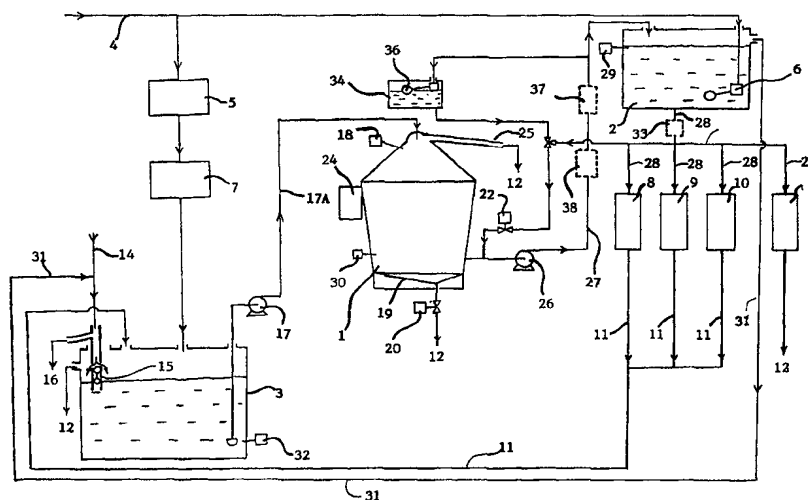




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>C02F 1/465</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/51622</b> <b>(43) International Publication Date:</b> 19 November 1998 (19.11.98)
<b>(21) International Application Number:</b> PCT/AU98/00342 <b>(22) International Filing Date:</b> 11 May 1998 (11.05.98)  <b>(30) Priority Data:</b> PO 6724 12 May 1997 (12.05.97) AU  <b>(71) Applicant (for all designated States except US):</b> AUS- TRALIAN WATER PURIFICATION LIMITED [AU/AU]; 8 Boronia Road, Vermont, VIC 3133 (AU).  <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> YANG, Thien, Siung [AU/AU]; 292 Connells Point Road, Connells Point, NSW 2221 (AU).  <b>(74) Agent:</b> ANDERSON-TAYLOR, Michael; 10 Harrison Avenue, Bonnet Bay, NSW 2226 (AU).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>

(54) Title: GREY WATER PURIFICATION AND RECYCLING SYSTEM



## (57) Abstract

There is a grey water supply and purification system comprising a storage reservoir (2) for purified grey water, a storage reservoir (3) for contaminated grey water and a grey water purification tank (1) which is connected between reservoirs (2 and 3). There is a pump and conduit system (28, 33) for the supply of purified grey water from the reservoir (2) for usage such as hand basins (8), bath/shower (9), laundry (10) and toilet (13). There is a conduit system (11) for discharging contaminated grey water from such usage (other than toilet usage) to the reservoir (3) and pump and conduit system (17, 17A) for supplying grey water to the purification tank (1). There is also a pump (26) and conduit (27) for replenishing the reservoir (2) with purified water from the tank (1). The pumps are controlled by a microprocessor (24).

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

<b>AL</b>	Albania	<b>ES</b>	Spain	<b>LS</b>	Lesotho	<b>SI</b>	Slovenia
<b>AM</b>	Armenia	<b>FI</b>	Finland	<b>LT</b>	Lithuania	<b>SK</b>	Slovakia
<b>AT</b>	Austria	<b>FR</b>	France	<b>LU</b>	Luxembourg	<b>SN</b>	Senegal
<b>AU</b>	Australia	<b>GA</b>	Gabon	<b>LV</b>	Latvia	<b>SZ</b>	Swaziland
<b>AZ</b>	Azerbaijan	<b>GB</b>	United Kingdom	<b>MC</b>	Monaco	<b>TD</b>	Chad
<b>BA</b>	Bosnia and Herzegovina	<b>GE</b>	Georgia	<b>MD</b>	Republic of Moldova	<b>TG</b>	Togo
<b>BB</b>	Barbados	<b>GH</b>	Ghana	<b>MG</b>	Madagascar	<b>TJ</b>	Tajikistan
<b>BE</b>	Belgium	<b>GN</b>	Guinea	<b>MK</b>	The former Yugoslav Republic of Macedonia	<b>TM</b>	Turkmenistan
<b>BF</b>	Burkina Faso	<b>GR</b>	Greece	<b>ML</b>	Mali	<b>TR</b>	Turkey
<b>BG</b>	Bulgaria	<b>HU</b>	Hungary	<b>MN</b>	Mongolia	<b>TT</b>	Trinidad and Tobago
<b>BJ</b>	Benin	<b>IE</b>	Ireland	<b>MR</b>	Mauritania	<b>UA</b>	Ukraine
<b>BR</b>	Brazil	<b>IL</b>	Israel	<b>MW</b>	Malawi	<b>UG</b>	Uganda
<b>BY</b>	Belarus	<b>IS</b>	Iceland	<b>MX</b>	Mexico	<b>US</b>	United States of America
<b>CA</b>	Canada	<b>IT</b>	Italy	<b>NE</b>	Niger	<b>UZ</b>	Uzbekistan
<b>CF</b>	Central African Republic	<b>JP</b>	Japan	<b>NL</b>	Netherlands	<b>VN</b>	Viet Nam
<b>CG</b>	Congo	<b>KE</b>	Kenya	<b>NO</b>	Norway	<b>YU</b>	Yugoslavia
<b>CH</b>	Switzerland	<b>KG</b>	Kyrgyzstan	<b>NZ</b>	New Zealand	<b>ZW</b>	Zimbabwe
<b>CI</b>	Côte d'Ivoire	<b>KP</b>	Democratic People's Republic of Korea	<b>PL</b>	Poland		
<b>CM</b>	Cameroon	<b>KR</b>	Republic of Korea	<b>PT</b>	Portugal		
<b>CN</b>	China	<b>KZ</b>	Kazakstan	<b>RO</b>	Romania		
<b>CU</b>	Cuba	<b>LC</b>	Saint Lucia	<b>RU</b>	Russian Federation		
<b>CZ</b>	Czech Republic	<b>LI</b>	Liechtenstein	<b>SD</b>	Sudan		
<b>DE</b>	Germany	<b>LK</b>	Sri Lanka	<b>SE</b>	Sweden		
<b>DK</b>	Denmark	<b>LR</b>	Liberia	<b>SG</b>	Singapore		
<b>EE</b>	Estonia						

-1-

## GREY WATER PURIFICATION AND RECYCLING SYSTEM

### BACKGROUND OF THE INVENTION

This invention relates to water supply systems for commercial, industrial and domestic establishments. More particularly although not exclusively it provides an improved system which minimises both consumption of potable water and discharge of sewer effluent.

Domestic households, hotels and restaurants etc. typically use large amounts of potable town water. Moreover, this water is subsequently discharged into the sewer system immediately after use. Existing systems are thus very wasteful of town water and also place a heavy load on sewage treatment. This poses a threat to potable water supplies and further generates excessive quantities of sewer effluent which is discharged back into the environment.

### SUMMARY OF THE INVENTION

It is therefore an object of this invention to ameliorate the aforementioned disadvantages and accordingly there is disclosed a water supply and purification system comprising a first storage reservoir for purified grey water, a second storage reservoir for contaminated grey water and a grey water purification means connected between said first and second reservoirs, means for supplying purified grey water

-2-

from said first reservoir for usage, means for discharging contaminated grey water from said usage (excluding toilet usage) to said second storage reservoir, means to supply said contaminated grey water from said second reservoir to said purification means for processing thereof, means to replenish said first reservoir with purified grey water from said purification means and means to make up said first reservoir against any loss of grey water with additional water to said system.

The term "grey water" is used in this specification to indicate waste water from the use of the kitchen sink, hand basin, bath, shower, laundry or the like but excluding the toilet.

#### BRIEF DESCRIPTION OF THE DRAWING

The attached figure 1 shows a schematic diagram of the currently preferred form of a grey water purification and recycling system according to this concept.

#### DESCRIPTION OF PREFERRED EMBODIMENT

The system may comprise a processing tank 1 of say 125 litres, a purified grey water storage tank 2 of say 500 litres, and a contaminated grey water storage tank 3 of say 2000 litres. Preferably but not essentially the processing tank 1 is situated at ground level, the purified grey water tank 2 is located at the ceiling or roof level of a building and the contaminated grey water storage tank 3 is

-3-

mainly below ground level.

Typical town water 4 is presumed to be clear and drinkable and in accordance with this invention is supplied only to the kitchen taps 5 and to a low level make up tap 6 (with float ball valve) in the purified grey water storage tank 2. Water from kitchen usage is passed first through a conventional grease trap 7 which retains substantially all the oil, grease and fat. This grey water is then discharged into the tank 3. All contaminated grey water from hand basin 8, bath/shower 9, and laundry 10 usage is also discharged to the storage tank 3 via conduits 11. Overflow from this tank 3 is discharged into the sewer system 12 as shown. Flush water from the toilet 13 is not recycled but rather is also discharged directly into the sewer system 12. Any rain water 14 collected from the building roof, garden and paths etc. is preferably discharged into the storage tank 3. When this storage tank 3 is close to full but before overflow a ball diversion device 15 directs any excess rain water to the storm water drain 16 to avoid unnecessary flow into the sewer.

When the processing tank 1 is activated pump 17 is also turned on to draw grey water from the storage tank 3 to fill the tank 1 through conduit 17A. After the tank 1 is filled to the required level as indicated by level switch 18 the pump 17 is turned off and the contaminated grey

-4-

water therein is purified. Preferably the tank 1 operates using a process of electrolysis whereby an electric potential is applied between two or more electrodes (not shown) which are submerged in said tank. The chemical reactions at these electrodes produce bubbles of hydrogen and oxygen as well as floc. The floc binds with impurities in the water and is then carried with the bubbles up to the water surface where it can be collected and disposed of. The bottom 19 of the processing tank 1 is preferably cone shaped to provide a low point for collection of any heavy sediment which cannot be flushed out from the top. A solenoid valve 20, is controlled by a central microprocessor 21 to discharge this sediment periodically. The currently preferred operation of the processing tank 1 is more fully described in the applicant's co-pending Australian patent application 61885/98.

Typical processing time for a 125 litre tank would be about three hours. All processing procedures and the necessary sequences involved are preferably controlled by the central microprocessor 21. When the purification of the grey water is almost completed the controller 21 opens a solenoid control valve 22 to let previously purified grey water flow from the tank 2 into tank 1 through conduit 23 so that the floc floating in the cone shaped top 24 is displaced out through an overflow chute 25 to the sewer 12. When the processing is completed the controller 21 then turns on the

-5-

pump 26 which discharges the purified grey water into the storage tank 2 through conduit 27. The water in this tank 2 is then supplied through conduits 28 for non-potable usage in the aforementioned hand basins 8, bath/shower 9, laundry 10 and toilet 13. When the level of purified grey water in the tank 2 reaches a predetermined maximum it is detected by a level switch 29 and the pump 26 is turned off. Alternatively when the level of water in the processing tank 1 falls to a predetermined minimum as detected by level switch 30 the pump 26 is also turned off. As mentioned earlier a tap and ball float valve 6 is preferably provided in the tank 2 to enable town water 4 to be added as required to make up for any loss or short fall of purified grey water. Any excess purified grey water in tank 2 is discharged back into the contaminated grey water tank 3 through conduit 31. When the level in tank 3 is low as detected by low level switch 32, the controller 21 stops the pumping of contaminated grey water to the processing tank 1.

For some areas where there is no town water supply the purified grey water can be used for drinking and kitchen use. For such applications it may be necessary to add a precautionary device in the purified grey water line 27 to further ensure that should any living organisms such as bacteria, virus and algae slip through the system they will be killed before the water enters the purified grey water

-6-

storage tank 2.

For applications where the purified grey water storage tank 2 may have to be located at ground level or where the user requires higher water pressure a pressure boosting pump 33 of any suitable design may be added to the purified grey water outlet line 28.

For mass produced commercial units, instead of using purified grey water from tank 2 it may be preferably to add a small flush water tank 34 immediately above the processing tank 1. This tank would be filled by the purified grey water pump 26 via line 35 and would preferably have a capacity approximately 10% of the processing tank capacity. When this tank is full a ball float valve 36 inside closes to prevent overflow.

For some countries where regulations require it or as a precaution against possible malfunction of the purification mechanism or to make the purified grey water potable a silver ion dosing device 37 or ultra-violet ray disinfectant device 38 may be added to the purified grey water line 27 before it discharges into tank 2. The silver ion dosing device 37 may be either a unit specially designed for the system or a commercially available unit. It is preferably adapted for dosing silver ion to a level of 0.02 to 0.05 mg/litre or any other level necessary to



-7-

kill the organisms in the water while still being safe for human consumption.

The ultra-violet disinfectant device 38 may also be either a unit specially designed for the system or a commercially available unit.

Other devices such as activated carbon or Zcolite absorption devices may also be used in lieu of the silver and ultra-violet devices.

It will thus be appreciated that this invention at least in the form of the example disclosed provides a novel and useful improvement to water supply systems. By collecting grey waste water from areas such as the kitchen, laundry, bath, shower and wash basin for purification and reuse it is envisaged that consumption of potable town water can be reduced by up to 75%. Sewer effluent may also be reduced by up to 75%. The system at least in the form described provides a balanced and self contained water purification recycling system which requires no manual intervention and can operate continuously without maintenance for many months except for normal grease trap clearing. No additive of any kind needs to be provided during the life of the system. It is to be understood however that the embodiment disclosed is only the currently preferred form of this invention and a wide variety of modifications may be made

-8-

to the system. For example the invention is not limited to any particular shape or capacity for the processing tank or storage tanks as these may be changed according to application.

-9-

The claims defining the invention are as follows:

1. A water supply and purification system comprising a first storage reservoir for purified grey water, a second storage reservoir for contaminated grey water and grey water purification means which in use of said system is connected between said first and second reservoirs, means for supplying purified grey water from said first reservoir for usage, means for discharging contaminated grey water from said usage (other than toilet usage) to said second storage reservoir, means to supply said contaminated grey water from said second reservoir to said purification means for processing thereof, means to replenish said first reservoir with purified grey water from said purification means and means to enable make up of loss of grey water from said system.

2. The water supply and purification system as claimed in claim 1 wherein said grey water purification means uses a process of electrolysis whereby an electric potential is applied between two or more electrodes submerged in a processing tank.

3. The water supply and purification system as claimed in claim 2 wherein said means to supply said contaminated grey water from said second reservoir to said purification means and said means to replenish said first reservoir with

-10-

purified grey water from said processing means include pump means controlled by a microprocessor.

4. The water supply and purification system as claimed in claim 3 wherein said microprocessor is operatively associated with level sensing switches in said first and second storage reservoirs and said processing tank whereby water therein is maintained within predetermined maximum and minimum levels.

5. The water supply and purification system as claimed in claim 4 wherein said grey water purification means includes a flush water tank located above said processing tank, said flush water tank having a smaller capacity than said processing tank.

6. The water supply and purification system as claimed in claim 5 wherein during use of said system the flush water tank holds grey water previously purified in said processing tank.

7. The water supply and purification system as claimed in claim 6 wherein said means to make up against loss of grey water from said system is adapted to use a source of potable town water.

8. The water supply and purification system as claimed in

-11-

claim 7 wherein said first storage reservoir is located higher than said second storage reservoir.

9. The water supply and purification system as claimed in claim 8 wherein the bottom of said processing tank is cone shaped to provide a low point or sump for collection of heavy sediment from the purification process and an outlet valve controlled by said microprocessor is provided to periodically discharge said sediment from the tank.

10. The water supply and purification system as claimed in claim 9 wherein means are provided to direct accumulated rain water into said second storage reservoir.

11. The water supply and purification system as claimed in claim 10 wherein said means for supplying purified grey water from said first reservoir for usage includes a pressure boosting pump.

12. The water supply and purification system as claimed in claim 11 wherein water from toilet usage is discharged directly to a sewer.

13. The water supply and purification system as claimed in claim 12 wherein said means to replenish said first reservoir from said processing means includes a disinfecting means and said usage includes potable usage.

-12-

14. The water supply and purification system as claimed in claim 13 wherein said disinfecting means includes a silver dosing device and/or an ultra-violet ray device.

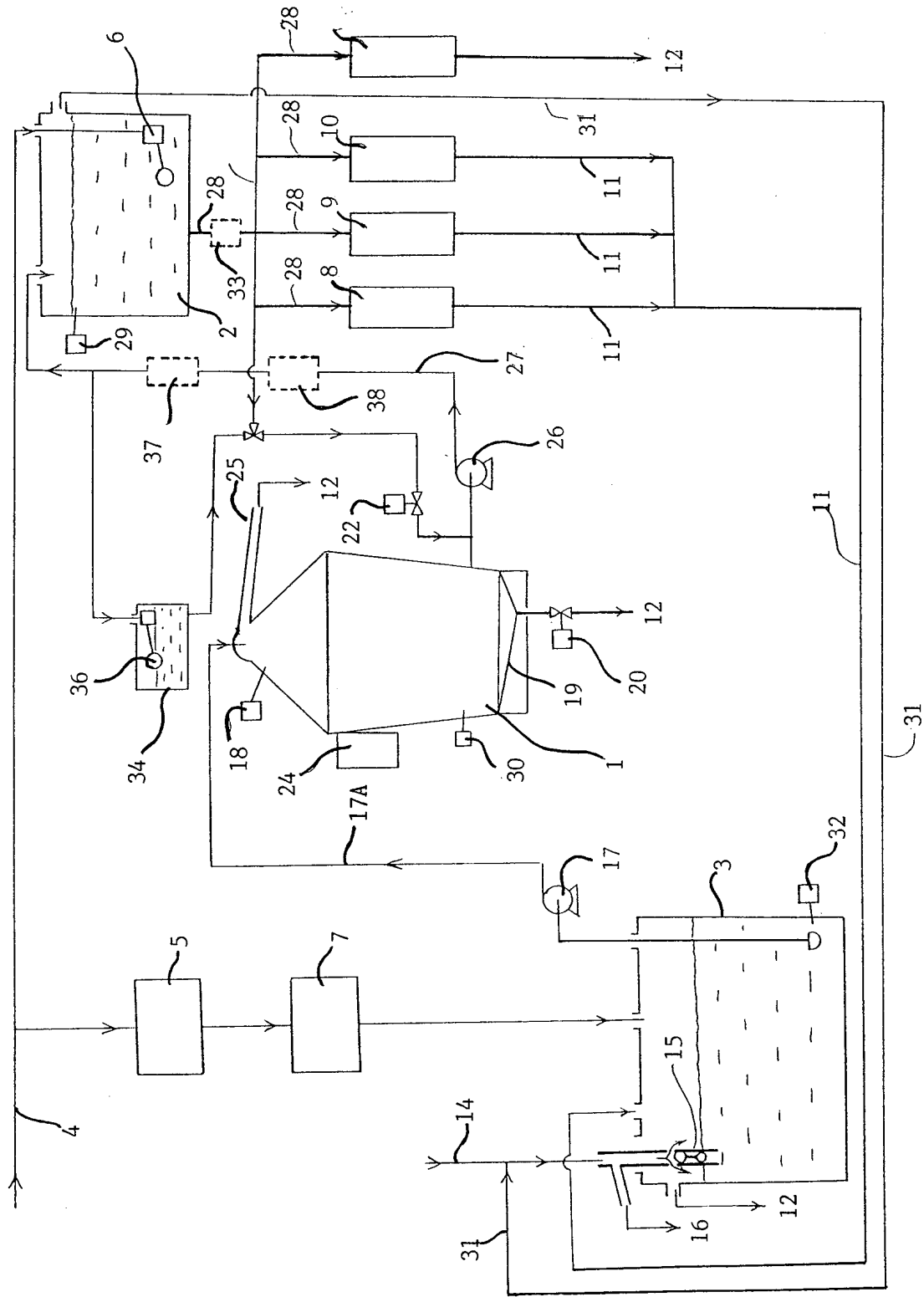


FIGURE 1

**INTERNATIONAL SEARCH REPORT**International Application No.  
**PCT/AU 98/00342**

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>																						
Int Cl <sup>6</sup> : C02F 1/465																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
<b>B. FIELDS SEARCHED</b>																						
Minimum documentation searched (classification system followed by classification symbols) IPC : C02F 1/465, 1/68, 1/28, 1/32, 1/00																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT : IPC as above with keywords grey, gray, secondary and night JAPIO : As for WPAT																						
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X Y	US 5573677 A (DEMBROSKY) 12 November 1996 Column 1, line 65 - column 2, line 33 and figure 1	1-6 7-14																				
X Y	US 5288412 A (VOORHEES et al.) 22 February 1994 Column 3, line 25 - column 4, line 8 and figure 1	1-6 7-14																				
X Y	DE 4435304 C1 (ZEISEL) 1 October 1994 Figure 1 and the abstract	1-2 3-14																				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C																						
<input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"><tr><td>"A"</td><td>document defining the general state of the art which is not considered to be of particular relevance</td><td>"T"</td><td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td></tr><tr><td>"E"</td><td>earlier document but published on or after the international filing date</td><td>"X"</td><td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td></tr><tr><td>"L"</td><td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td><td>"Y"</td><td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td></tr><tr><td>"O"</td><td>document referring to an oral disclosure, use, exhibition or other means</td><td>"&amp;"</td><td>document member of the same patent family</td></tr><tr><td>"P"</td><td>document published prior to the international filing date but later than the priority date claimed</td><td></td><td></td></tr></table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier document but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																			
"E"	earlier document but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																			
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search 5 June 1998		Date of mailing of the international search report <b>17 JUN 1998</b>																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer  <b>SUDATH KUMARASINGHE</b> Telephone No.: (02) 6283 2269																				



**INTERNATIONAL SEARCH REPORT**

International Application No.

**PCT/AU 98/00342**

<b>C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5453203 A (HIGUCHI) 26 September 1995 Abstract and the diagram	1-9, 13-14
Y	Patent Abstracts of Japan, JP 07-116667 A (KUIISHI SHICKIROU) 9 May 1995 The abstract	1-2
Y	Patent Abstracts of Japan, JP 07-232983 A (TANAKA-TOMOJI) 5 September 1995 The abstract	1-2
A	US 5549812 A (WITT a.k.a. WITTE) 27 August 1996	1-14
A	DE 3630874 A (VEB KOMBINAT POLYGRAPH) 9 April 1987	1-14

## INTERNATIONAL SEARCH REPORT

### Information on patent family members

International Application No.  
PCT/AU 98/00342

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5573677						
US	5288412						
DE	4435304						
US	5453203	DE	4335996	JP	613449	CN	1100701
JP	07-116667						
JP	07-232983						
US	5549812	CA	2145326	CN	1126178	CZ	9500746
		DE	4410658	EP	673883	JP	8039074
DE	3630874	DD	245018	DD	281545		